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A New Species, *Caelorinchus sheni*, and 19 New Records of Grenadiers (Pisces: Gadiformes: Macrouridae) from Taiwan

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Mei-Luen Chiou, Kwang-Tsao Shao and Tomio Iwamoto (2004) A new species, *Caelorinchus sheni*, and 19 new records of grenadiers (Pisces, Gadiformes, Macrouridae) from Taiwan. *Zoological Studies* **43**(1): 35-50. This paper reports 1 new species, *Caelorinchus sheni* sp. nov., and 19 new records of grenadiers (Macrouridae) from Taiwan which were collected by bottom trawler and landed at the fishing harbors of Tashi and Nanfangao in northeastern Taiwan and Tungkang in southwestern Taiwan. The diagnostic characters for *C. sheni* sp. nov. are the prominent banding pattern on the body, the large mouth with conical teeth in a relatively long band, and the anterolateral snout margin incompletely supported by bone. *Caelorinchus sheni* is similar to *C. quadricristatus* and *C. celaenostomus*. The 3 species differ in details of the dentition, the shape of the preopercle and subopercle, banding patterns, and proportions. The species newly recorded in Taiwan are *Bathygadus antrodes*, *B. garretti*, *B. nipponicus*, *Gadomus colletti*, *Caelorinchus asteroides*, *C. longissimus*, *C. productus*, *Hymenocephalus lethonemus*, *Hymenogadus gracilis*, *Kumba japonica*, *Lucigadus lucifer*, *Nezumia condylura*, *Pseudocetonurus septifer*, *Ventrifossa atherodon*, *V. divergens*, *V. longibarbata*, *V. macroptera*, *V. rhipidodorsalis*, *and V. saikaiensis*. In addition to the description of the new species and 19 new records, color photos of each species and a diagnostic key for all 40 species in the family Macrouridae are provided.
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Key words: Fish fauna, Macrouridae, Fish taxonomy, Deep-sea fishes, New species.

Grenadiers occupy all oceans from the low Arctic to Antarctic with most species living at depths of between 200 and 2000 m. The food of these fishes consists of a wide range of fish and both benthic and pelagic invertebrates. Most grenadiers are benthopelagic. Four subfamilies (or families, see Iwamoto 1990), 38 genera, and more than 375 species (Iwamoto 1990; personal records of TI) are currently recognized in the world. Three genera, *Caelorinchus*, *Coryphaenoides*, and *Nezumia*, comprise over 1/2 of the species.

The earliest literature reporting on grenadiers of Taiwan probably dates from 1920 when Gilbert and Hubbs listed 3 genera and 5 species from the region. In 1970, Okamura listed 3 genera and 7 species. Iwamoto (1990) listed 3 genera and 5 species. The first synoptic work on grenadiers of Taiwan was done by Shen (1984), who listed a total number of 3 genera and 9 species. Chen and Yu (1986) added 1 genus and 5 species. According to *Fishes of Taiwan* (Shen et al. 1993), 1 subfamily, 5 genera, and 19 species were known to occur in Taiwan. The present study attempts to review this group of fishes by re-examining previously deposited specimens and collecting new specimens retrieved by deep-sea bottom trawlers, which operate at the depths of from 300 to 800 m in northeastern waters near Tashi and Nanfangao and southwestern waters near Tungkang. Our preliminary results obtained total of 2 subfamilies and 11 genera. They include 2 new species of *Caelorinchus* and 19 new records. One of the new species, *C. leptorhinus*, has been described

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elsewhere (Chiou et al. 2004). The new present species, *C. sheni*, and the following 19 species described are newly added to the Taiwanese fauna: *Bathygadus antrodes*, *B. nipponicus*, *B. garretti*, *Gadomus colletti*, *Caelorinchus asteroides*, *C. brevirostris*, *C. longissimus*, *C. productus*, *Hymenocephalus lethonemus*, *Hymenogadus gracilis*, *Kumba japonica*, *Lucigadus lucifer*, *Nezumia condylura*, *Pseudocetonurus septifer*, *Ventrifossa atherodon*, *V. divergens*, *V. longibarbata*, *V. macroptera*, *V. rhipidodorsalis*, *and V. saikaiensis*. Thus, the total number of Macrouridae collected from the waters around Taiwan is increased to 40 species.

MATERIALS AND METHODS

Most specimens were collected by deep-sea bottom trawlers from the fishing ports of Tashi or Nanfangao in northeastern Taiwan, and from Tungkang on the southwestern coast of Taiwan. A portion of the specimens was borrowed from the collections of National Taiwan University (NTUM), Institute of Zoology, Academia Sinica (ASIZP), Tunghai University (THUP), and National Sun Yat-Sen University (NSYSU). All counts of meristic characters and measurements of morphometric characters follow Iwamoto (1990). Abbreviations used for characters include: A, anal fin; ADW, anterior dermal window; BD, body length; D, dorsal fin; GR-I, gill-rakers on 1st arch, GR-II, gill-rakers on 2nd arch; HL, head length; LP-A, distance between base of outer pelvic ray and anal origin; LR, longitudinal scale rows in a series from the middle of the 1st dorsal base; Orbit, greatest orbit diameter; P, pectoral fin; Pc, pyloric caeca; PDW, posterior dermal window; PO, preoral length of snout; Postorb, least postorbital length of head; SL, snout length; TL, total length; and V, pelvic fin. Descriptions of body coloration are based on fresh specimens. All specimens we collected are deposited at the Institute of Zoology, Academia Sinica (ASIZP) and National Taiwan University (NTUM).

Family Macrouridae

Key to subfamilies, genera, and species of the family Macrouridae in Taiwan

1a. Second dorsal fin better developed than anal fin and starting close behind 1st dorsal; outer gill rakers on 1st arch slender, lathlike, not tubercular; outer gill slit not restricted by folds of skin connecting upper and lower extent of 1st gill arch with operculum (Bathygadinae) 2
1b. Anal fin better developed than 2nd dorsal; with distinct gap between dorsal fins; gill rakers all tubercular; outer gill slit restricted by folds of skin (Macrourinae) 5
2a. Barbel always present, much longer than orbit; teeth exceedingly minute, in villiform bands; interopercle high and trapezoid; olfactory bulbs in contact with forebrain..... ..... *Gadomus colletti*
2b. Barbel present or absent, if present, much shorter than orbit; teeth coarser, granular, in bands; interopercle slender, posterior portion directed downward; olfactory bulbs between orbits (*Bathygadus*)..... 3
3a. Head exceedingly broad; interorbital space much wider than 1.5-times diameter of orbit; gill-rakers exceeding 26; mandibular ramus with a single series of scales; no barbel ..... *Bathygadus antrodes*
3b. Head moderately broad; interorbital space narrower than 1.5-times diameter of orbit; gill-rakers fewer than 23; mandibular ramus with 1.5 or 2 series of scales; barbel present or absent..... 4
4a. Barbel absent; pelvic rays 9 .....*Bathygadus nipponicus*
4b. Minute barbel present; pelvic rays 10 or 11..... .....*Bathygadus garretti*
5a. Six branchiostegal rays (*Caelorinchus* and *Coryphaenoides*)..... 6
5b. Seven branchiostegal rays 23
6a. Gill-rakers absent on lateral side of 1st gill arch 7
6b. Gill-rakers present on lateral side of 1st gill arch..... .....*Coryphaenoides microps*
7a. Body scales strongly developed; light organ short, anterior end not crossing forward of line connecting pelvic fin bases 8
7b. Body scales weak; light organ long, anterior end crossing forward of line connecting pelvic fin bases 16
8a. Little or no external evidence of light organ..... 9
8b. A distinct blackish fossa of light organ on belly 11
9a. Prominent vertical bars on body .....*Caelorinchus sheni*
9b. Body without vertical bars 10
10a. Underside of head scaled; spinule rows parallel..... .....*Caelorinchus parallelus*
10b. Underside of head naked; spinule rows divergent ....*Caelorinchus gilberti*
11a. Scale spinules in 1 row between occipital ridges ....*Caelorinchus japonicus*
11b. Scale spinules with several diverging rows between occipital ridges 12
12a. Spinules of median nasal ridge scales in stellate arrangement .....*Caelorinchus asteroides*
12b. Spinules of median nasal ridge scales in divergent arrangement 13
13a. Underside of head scaled .....*Caelorinchus smithi*
13b. Underside of head mostly naked.....14
14a. A patch of scales on ventral surface of preopercle..... .....*Caelorinchus leptorhinus*
14b. No small patch of scales on ventral surface of preopercle 15
15a. Body scales with stout spinules in 4 to 10 divergent rows.... .....*Caelorinchus anatirostris*
15b. Body scales with weak spinules in 3 to 5 divergent rows.... .....*Caelorinchus productus*
16a. A prominent blackish blotch above and behind pectoral fin base .....*Caelorinchus kishinouyei*
16b. No blackish blotch behind pectoral fin base 17
17a. Spinules on body scales relatively long and slender; spinule rows parallel..... 18

17b. Spinules on body scales short; spinule rows divergent..... 19
18a. Prominent body markings consisting mostly of blotches and saddle marks; spinous 2nd ray short, less than HL..... .....*Caelorinchus cingulatus*
18b. No body markings; spinous 2nd ray developed and elongated to greater than HL.....*Caelorinchus brevirostris*
19a. Three longitudinal streaks on body; 2nd dorsal fin high..... .....*Caelorinchus hubbsi*
19b. No body marks; 2nd dorsal fin low 20
20a. A small patch of scales ventrally on preopercle..... .....*Caelorinchus formosanus*
20b. Preopercle naked 21
21a. Body markings prominent, consisting of broken stripes..... .....*Caelorinchus multispinulosus*
21b. Body markings not prominent 22
22a. Pelvic fins uniformly blackish; spinules short, triangular .....*Caelorinchus kamoharai*
22b. Pelvic fins not blackish; spinules slender and weak..... .....*Caelorinchus longissimus*
23a. Ventral striae on gular membrane, side of isthmus, over shoulder girdle; integument of head membranous, essentially transparent; head bones thin, fragile 24
23b. No ventral striae; head integument thick; head bones not especially fragile 27
24a. Spinous dorsal ray serrated; fewer than 15 inner gill rakers on lower limb of 1st arch ..... *Hymenogadus gracilis*
24b. Spinous dorsal ray smooth; more than 15 inner gill rakers on lower limb of 1st arch 25
25a. No chin barbel, pelvic fin rays 11 to 12..... .....*Hymenocephalus lethonemus*
25b. Chin barbel long, pelvic fin rays 8 26
26a. Barbel length more than orbit length..... ..... *Hymenocephalus longiceps*
26b. Barbel length less than orbit length..... .....*Hymenocephalus striatissimus*
27a. Lateral line scales absent ..... *Pseudocetonurus septifer*
27b. Lateral line scales present 28
28a. Lower jaw teeth large, widely spaced, in 1 row; scales present on lowermost branchiostegal rays..... ..... *Malacocephalus laevis*
28b. Lower jaw teeth moderate to small, closely spaced, in more than 1 row; no branchiostegal scales 29
29a. Upper jaw extending posteriorly beyond orbit 30
29b. Upper jaw not extending posteriorly beyond orbit 39
30a. Second spiny ray smooth ..... *Ventrifossa macroptera*
30b. Second spiny ray serrated 31
31a. Pores of head rather prominent 32
31b. Pores of head small, inconspicuous 33
32a. Pelvic fin rays 7 to 8 .....*Lucigadus lucifer*
32b. Pelvic fin rays 10 to 12 ..... *Lucigadus nigromarginata*
33a. Spinules on body scales broadly triangular..... ..... *Ventrifossa garmani*
33b. Spinules on body scales conical to narrowly lanceolate..... 34
34a. Above longitudinal stripe, body and tail with dusky band.... .....*Ventrifossa atherodon*
34b. Above longitudinal stripe, body and tail without dusky band 35
35a. A prominent black blotch on 1st dorsal fin 36
35b. First dorsal fin uniformly dusky or somewhat darker basally 38
36a. Anal fin with a black margin anteriorly..... .....*Ventrifossa rhipidodorsalis*
36b. Anal fin without a black margin anteriorly 37
37a. Barbel length greater than orbit length..... .....*Ventrifossa longibarbata*
37b. Barbel length less than orbit length..... .....*Ventrifossa nigrodorsalis*
38a. Scale pockets brown ..... *Ventrifossa saikaiensis*
38b. Scale pockets not dark-edged ..... *Ventrifossa divergens*
39a. Suborbital ridge developed .....*Nezumia condylura*
39b. Suborbital ridge weak ..... *Kumba japonica*

***Caelorinchus sheni* sp. nov.**

(Fig. 1)

Material examined: *Holotype*: ASIZP 061348, ♀ (113 mm HL, 420+ mm TL), northeastern Taiwan, off Tashi; 24°54'63''N, 120°03'49''E, in 400-650 m; taken by trawler "*Gin Ton Long*", 30 May 2001.

Paratypes: ASIZP 061232, ♀ (257 mm HL, 937+ mm TL); Lauto; 22°20'05''N,120°12'12''E; 1 Mar. 1999. CAS 215541 (110 mm HL, 427 mm TL); Taiwan, 2002.

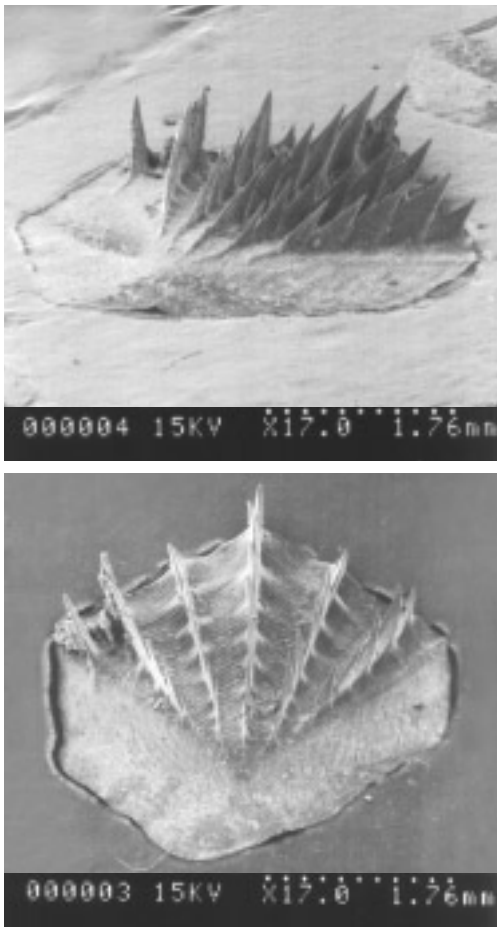
Diagnosis: A species of the genus *Caelorinchus*, Group II, as defined by Iwamoto (1990), characterized by the following combination of characters: snout relatively long, length about 2.5 in HL, with blunt tip, anterolateral margin incompletely supported by bone; suborbital ridge composed of 2 rows of thick, stout, modified scales; orbit large, about 2.0 in snout length; mouth opening large, rictus more than 2/3 length of upper jaw; opercular opening far forward, with a free fold across isthmus; underside of head scaled; nasal fossa fully scaled; body scales large, with 5-7 sharp, divergent rows of spinules; light organ small with a short and slender blackish streak; numerous prominent saddle markings on body; dusky triangular marking anteriorly on isthmus.

Description: *Counts*: 1D. II, 8-9; Pi.18-19; V. rays 7; GR-I (inner) 9-10, GR-II (outer) 6-8; scales

Fig. 1. *Caelorinchus sheni* n. sp. Holotype, ASIZP0061348, 113 mm HL, 420+ mm TL, from the northeastern coast of Taiwan in 400-650 m.

below 1D. 4.5-5, below 2D. 5-6, lat. line 33-41. Measurements: TL of specimens examined 420-937+ mm; HL 113-257 mm. The following in percent of HL: snout length 41-56; preoral length 32-26 internasal width 20-21; interorbital width 25-26; orbit diameter 20-21; suborbital width 6-8; postorbital length 37-40; distance from orbit to angle of preopercle 39-42; upper jaw length 30-37; barbel length 9-11; length of 1st gill slit 10-13; preanal length 30-42; greatest body depth 61-64; body depth at A. origin 45-46; interspace between 1st and 2nd dorsal fins 22-23; height 1D. 45-48; length P. 44-50; length outer V. ray about 42; outer V. to A. about 37.

Head about 3.6-3.7 in TL, greatest width more than snout length. Body relatively stout depth about 5.7-6.5 in TL. Snout in lateral view deep, dorsal profile gently convex; viewed dorsally, snout narrow with gently curving sides. Terminal snout scute small, tricuspid, blunt, heavy, and spiny. Orbit large, diameter about 1/2 length of snout.



Figs. 2-3. Scale from region below first dorsal fin (above lateral line). *Caelorinchus sheni*, ASIZP0061348 (113 mm HL).

Length of postorbital less than that of pectoral fin. Interorbital space wide, about 1.2-1.3 into orbit. Terminal angle of subopercle forming broad flap. Suborbital ridge well developed along entire length, 2 stoutly spinulated rows along preopercular section and under orbit, latter series separated from ventral margin of orbit by 2 rows of much-smaller scales. Opercular opening large, extending to below posterior margin of orbit, with a narrow free fold of gular membrane across isthmus. Mouth rather large , snout tip below anterior nostril; rictus length greater than 2/3 of upper jaw length; maxilla not extending beyond posterior margin of orbit; lips thick and fleshy. Posterior nostrils large. Chin barbel slender and short, equal to about 1/2 orbit diameter.

Premaxillary teeth conical, in long broad bands occupying about 2/3 of upper jaw, peripheral teeth enlarged. Mandibular teeth villiform, in long broad band extending entire length of rictus.

Body scales large, covered with sharp, overlapping, recurved, blade-like spinules, arranged in 5-7 widely divergent, ridge-like rows (Figs. 2, 3); base of spinules with buttresses. Scales of head ridges stout but not particularly prominent except along suborbital ridge. No enlarged occipital or supraoccipital scale. Underside of head completely and uniformly covered with small scales encircled by small spinules aligned in longitudinal rows. Nasal fossa covered with small scales anteriorly and ventrally.

Size and position of fins shown in figure 4. Origin of 1st dorsal fin above base of pectoral fin. Rays of 2nd dorsal fin about 1/2 length of opposites of anal fin. Interdorsal space about equal to base of 1st dorsal fin. Anal fin origin slightly anterior to origin of 2nd dorsal fin. Pectoral fin long, pointed, and narrow; its tip extending beyond origin of anal fin. Outer pelvic fin ray prolonged, extending to origin of anal fin.

Ground color uniformly light brownish; bluish on abdomen. At least 15 broad, brownish saddle markings on body from trunk to tip of broken tail,

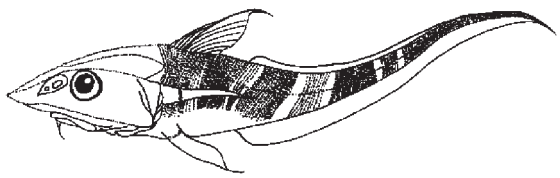


Fig. 4. *Caelorinchus sheni* n. sp. Holotype, ASIZP 0061348, 113 mm HL, 420+ mm TL, from the northeastern coast of Taiwan in 400-650 m.

the 1st beginning on nape below base of 1st dorsal fin, saddles alternatively deep brown and light brown. All saddle-like markings extending below midlateral line. Posterior portion of supraoccipital, anterior margin of opercle, lips, barbel, gill membranes, and 2nd dorsal fin pale. All anterior parts of head from behind orbits to snout tip appearing pale in photographs, even on the underside of head. Anterior part of supraoccipital, occipital region, oral cavity, underside of head, gill cavity, and ramus of lower jaw dark. Most of opercle, a triangular section on chest, pelvic fins (but not prolonged outer ray, which is white), and margin of anal fin blackish.

Size: To greater than 937 mm TL.

Distribution: Known only from 3 specimens captured off northeastern and southeastern Taiwan at 450-650 m in depth.

Etymology: Named in honor of Dr. S.C. Shen of National Taiwan Univ., for his many contributions to ichthyology.

Comparisons: *Caelorinchus sheni* closely resembles *C. quadricristatus* Alcock, 1891 from the Indian Ocean and *C. celaenostomus* McMillan and Paulin, 1993 from New Caledonia and New Zealand. The 3 appear to form a species group characterized by each having the combination of incomplete support of the anterolateral snout margin, similar dentition and squamation, prominent saddle marks, a similar snout shape, a large mouth, a small light organ, and a fully scaled underside of the head. *C. aelorinchus hexfasciatus* Okamura, 1982, *C. longicephalus* Okamura, 1982, and *C. tokiensis* (Steindachner and Döderlein, 1887) are also closely similar to these species except that the underside of the head is almost entirely naked (a patch of scales usually present on ventral surface of preopercle).

C. celaenostomus differs from *C. sheni* in the uniformly brownish color of the saddles and the orientation of the markings: in *C. sheni* all saddles extend downwards and backwards from the dorsal profile; in *C. celaenostomus* the saddles on the trunk and those below the anteriormost part of the 2nd dorsal fin extend more or less downwards and forwards, while those behind are defined by pale interspaces that go both ways. Scales on top of the head and the general shape of the snout and head differ, and the subopercle in *C. celaenostomus* terminates in a slender flexible flap. The preopercle is more rounded in *C. sheni*. The chin barbel in *C. celaenostomus* is longer and stouter, the lips thicker, the pelvic fins shorter (not extending beyond the origin of the anal fin), the light organ lacks an external blackish streak, and the gill opening does not extend as far forward as in *C. sheni*. Morphometric differences include orbit diameter (1.7-1.9 in snout length in *C. celaenostomus* cf. 2.0 in *C. sheni*), internasal width (12%-20% HL cf. 20.6%-21%), head width (about equal to or less than snout length cf. more than snout length), suborbital width (8%-14% HL cf. 6%).

C. quadricristatus differs from *C. sheni* in having the saddle-like markings not crossing the midlateral line of the abdomen; the anal fin uniformly pale to dusky and lacking a blackish margin; a sharper, narrower terminal snout scute; and the 2nd dorsal fin beginning closer behind the 1st (interdorsal space about 1/2 D1 base in *C. quadricristatus* cf. about equal to D1 base in *C. sheni*).

C. sheni and *C. tokiensis* are the only species of the genus from Taiwan waters having prominent saddle-like markings on the body. *C. tokiensis* differs from *C. sheni* in having a slightly longer snout, the underside of head almost entirely naked, and most scales between occipital ridges with spinules arranged in a single keel-like row.

Remarks: A rare species, the huge specimen of attaining 937+ mm TL was taken by a commercial trawler at about 600 m in depth. It is the largest specimen ever seen in this genus. The species of *C. longicephalus* Okamura, 1982 was the previous record holder at 89 cm, although *C. celaenostomus* approached 83 cm TL. Most adults of the species of this genus are less than 30 cm in TL. The holotype shows differences from the smaller paratype in dentition, body proportions, and color. The teeth size, head length, trunk length, and terminal snout scute are all relatively shorter than in the paratype. The pectoral fin in the holotype is uniformly blackish, but paler in the paratype.

Bathygadus **Günther, 1878**

Bathygadus Günther, 1878: 23 (type-species by original designation: *Bathygadus cottoides* Günther).

There are between 9 (Howes and Crimmen 1990) and 14 (Iwamoto 1990) species of this genus in the world, with 2 species reported in Taiwan.

Bathygadus antrodes **(Jordan & Gilbert, 1902)**
(Fig. 5)

Melanobranchus antrodes Jordan and Gilbert, 1902: 606, pl. 4. fig.1, Sagami Bay, Japan (original description).

Fig. 5. *Bathygadus antrodes*, ASIZP 061225, TL 635 mm.

Fig. 6. *Bathygadus garretti*, ASIZP 061228, TL 458 mm.

Fig. 7. *Bathygadus nipponicus*, ASIZP 061227, TL 362 mm.

Fig. 8. *Gadmus colletti*, ASIZP 061223, TL 363 mm.

Fig. 9. *Caelorinchus asteroides*, ASIZP 061339, TL 302 mm.

Fig. 10. *Caelorinchus longissimus*, ASIZP 061337, TL 202 mm.

Fig. 11. *Caelorinchus productus*, ASIZP 061326, TL 296 mm.

Fig. 12. *Hymenocephalus lethonemus*, ASIZP 061231, TL 126 mm.

Fig. 13. *Hymenogadus gracilis*, ASIZP 061229, TL 118 mm.

Fig. 14. *Kumba japonica*, ASIZP 061240, TL 162 mm.

Fig. 15. *Lucigadus lucifer*, ASIZP 061308, TL 110 mm.

Fig. 16. *Nezumia condylura*, ASIZP 061238, TL 186 mm.

Fig. 17. *Pseudoctenurous sepitfer*, ASIZP 061237, TL 147 mm.

Fig. 18. *Ventrifossa atherodon*, ASIZP 061311, TL 245 mm.

Fig. 19. *Ventrifossa divergens*, ASIZP 061309, TL 220 mm.

Fig. 20. *Ventrifossa longibarbata*, ASIZP 061242, TL 272 mm.

Fig. 21. *Ventrifossa macroptera*, ASIZP 061244, TL 199 mm.

Fig. 22. *Ventrifossa rhipidodorsalis*, ASIZP 061246, TL 170 mm.

Fig. 23. *Ventrifossa saikaiensis*, ASIZP 061248, TL 250 mm.

Materials: ASIZP 061225, 1 specimen, 635 mm TL, Dec. 1999, Tashi; ASIZP 061226, 1 specimen, 446 mm TL, Dec. 2000, Tashi.

Diagnosis: D1. II,7-9; P. i15-i16; V. 9; Scales 1D. 8-9, 2D. 9-10; GR-I (outer/inner) 26-30/19-21; Pc. 14-16. Head very wide and rather elongate. Bones of head soft and cavernous. Orbit small. Mouth terminal and oblique. Teeth minute, roughly equal, with arrow-shaped tip, set in broad band on premaxillary and in narrow band on dentary. No teeth on vomer or palatine. No barbel. Scales cycloid, small, and deciduous. Scales on mandibular ramus comparatively large, arranged in a single row.

Distribution: Southern Japan and northeastern Taiwan.

Bathygadus garretti **Gilbert & Hubbs, 1916**
(Fig. 6)

Bathygadus garretti Gilbert and Hubbs, 1916: 151, pl. 8, Suruga Gulf, Japan (original description).

Material: ASIZP 061228, 1 specimen, 458 mm TL, Dec. 1999, Tashi.

Diagnosis: D1. II, 9; P. i18; V. 10-11; Scales 1D. 7-8, 2D. 10-15; GR-I (outer/inner) 5+18/4+16; Pc. 49. Head moderately wide and comparatively firm, slightly longer than 1/2 length to vent. Snout low, not broad, slightly longer than or as long as orbit; width at frontal margin of orbit much narrower than twice preocular length. Orbit large. Mouth terminal and lateral, slightly oblique. Teeth minute, rather conical in shape, set in broad band on premaxillary and in narrow band on dentary. Scales small, cycloid, thin, and deciduous. Mandibular ramus with double scale rows, one of which consisting of large scales and the other smaller ones.

Distribution: Southern Japan and northeastern Taiwan.

Bathygadus nipponicus **(Jordan & Gilbert, 1902)**
(Fig. 7)

Regania nipponica Jordan and Gilbert, 1902 (1904): 605, Sagami Bay, Japan (original description). Jordan et al. 1913: 410.
Bathygadus nipponicus Gilbert and Hubbs, 1916: 142.

Material: ASIZP 061227, 1 specimen, 362 mm TL, June 2000, Tashi.

Diagnosis: D1. II, 9-10; P. i18; V. 9-10; Scales 1D. 7, 2D. 10; GR-I (outer/inner) 5+18/3+15; Pc. 49. Head moderately wide, longer than 1/2 length to vent. Snout low, broad, longer than or as long as orbit; width at frontal margin of orbit much narrower than preocular length. Orbit large. Mouth terminal and lateral, no chin barbel. Teeth minute, rather conical in shape, set in broad band on premaxillary and in narrow band on dentary. Scales cycloid. Mandibular ramus with double scale rows.

Distribution: Southern Japan and northeastern Taiwan.

Gadomus Regan, 1903

Gadomus Regan, 1903: 459 (type-species by original designation: *Bathygadus longifilis* Goode and Bean).

There are about 12 species of this genus in the world (Howes and Crimmen 1990, Iwamoto and Williams 2001); only 1 species occurs in Taiwan.

Gadomus colletti Jordan & Gilbert, 1904
(Fig. 8)

Gadomus colletti Jordan and Gilbert, 1904: 603, Suruga Bay, Japan (original description).
Bathygadus colletti Weber, 1913: 172 (listed).

Materials: ASIZP 061223, 1 specimen, 363 mm TL, Mar. 1999, Tashi; ASIZP 061224, 1 specimen, 382 mm TL, June 2001, Tashi.

Diagnosis: D1. II,9-12; P. i18-21; V. 8; Scales 1D. 7.5-8.5, 2D. 14-16; GR-I (outer/inner) 24-27/18-20; Pc. 105-134. Bones of head rather firm and not cavernous. Snout low, not blunt at tip, decidedly shorter than diameter of orbit and not protruding beyond mouth; width at frontal margin of orbit slightly wider than 1/2 length of snout. Mouth large, terminal, and lateral; teeth in villiform bands on both jaws. No teeth on vomer or palatine. Barbel filamentous, about as long as, or a little shorter than length of head. Gill-opening wide, extending to a vertical through center of pupil. Scales cycloid. Mandibular ramus provided with but 1 scale row. Color pale. Jaws white. All fins dusky; dorsal and anal fins darkening toward edge.

Distribution: Southern Japan and northeastern Taiwan.

Caelorinchus Giorna, 1810

Caelorinchus Giorna, 1810: 179 (type-species by original designation: *Lepidoleprus caelorhincus* Risso).
Krohnius Cocco, 1884: 1 (type-species by original designation: *Krohnius filamentosus* Cocco=*Coelorhynchus coelorhynchus* (Risso)).
Paramacrurus Bleeker, 1874: 370 (type-species by original designation: *Lepidoleprus australis* Richardson).
Oxymacrurus Bleeker, 1874: 370 (type-species by original designation: *Macrurus japonicus* Temminck and Schlegel).
Oxygadus Gilbert and Hubbs, 1920: 515 (as a subgenus of *Coelorhynchus* for *Macrurus parallelus* (Günther).

There are more than 100 valid species of this genus in the world (Eschmeyer 1998; personal data of TI); 17 species have been found in Taiwan.

Caelorinchus asteroides Okamura, 1963
(Fig. 9)

Coelorinchus asteroides Okamura, 1963: 21, figs.1-4, off Owase, Mie Pref., Japan (original description).

Materials: ASIZP 061339, 1 specimen, 302 mm TL, June 2000, Tashi; ASIZP 061340, 1 specimen, 310 mm TL, Dec. 2000, Tungkang.

Diagnosis: D1. II,8-9; P. i17-i19;GR-I (inner) 1+6; Scales 1D. 3-3.5, 2D. 4-4.5; Pc. 40-50. Head about as wide as deep, depressed anteriorly; middle of length of head behind anterior border of pupil. Snout short and broadly protruding, with acute rostral spine; lateral margin strongly curved. Teeth in premaxillaries conical, not arrow-shaped, in 5 to 8 irregularly oblique series, forming a wide band as a whole, those of outer series evenly enlarged and widely spaced. Scales on body large, hexagonal, and rather deciduous; spinules stout and pungent, forming 4-11 divergent ridges, last spinule of each series more or less projecting beyond apical margin of scales. Scales on head coarser, less imbricated, and more adhesive than those on body; scales 7 or 8 in a longitudinal series on nasal crest, with spinous rows radiating in all directions from center of each scale, spinules never on ridges but independently rising from surface of scales. This median series of scales followed on each side by a single series of less-modified scales. Nasal fossa naked. No naked area on dorsal surface of snout, but a naked groove extending from base of rostral spine backward to interorbital space alongside median rostral series of scales. Underside of head, including mandibular regions and branchiostegal membranes, entirely naked. Vent immediately before anal fin and preceded by a luminous organ of short type.

Distribution: Southern Japan and Taiwan.

Caelorinchus longissimus Matsubara, 1943
(Fig. 10)

Coelorinchus longissimus Matsubara, 1943: 140, fig. 5 (type locality, Kumano-Nada, Japan).

Materials: ASIZP 061337, 1 specimen, 202 mm TL, Mar. 1999, Tashi; ASIZP 061338, 1 specimen, 292 mm TL, Tungkang.

Diagnosis: D1. II,8-10; P. i16-i20; GR-I (inner) 2+6; Scales 1D. 3-4.5, 2D. 3.5-4.5; Pc. 16-23. Head large, about as wide as deep, usually longer than 1/4 total length of body. Orbit oval, moderate in size. Sensory canals on head spacious. Mouth small, entirely inferior. Teeth conical. Scales near-

ly hexangular, thin and rather deciduous; spinules weak, slender, in 6-14 divergent rows. A large naked area present dorsally behind anterolateral margin of snout. Nasal fossa largely naked. Luminous organ long, superficial blackish streak about as long as head exclusive of snout; anterior photophore fossa-like, but scaled.

Distribution: Southern Japan and Taiwan.

Caelorinchus productus Gilbert & Hubbs, 1916
(Fig. 11)

Caelorhynchus productus Gilbert and Hubbs, 1916, 51: 175, pl. 9, fig. 1 (Suruga Gulf, Japan, 360 - 543 m).

Materials: ASIZP 061326, 1 specimen, 296 mm TL, May 2000, Tashi; ASIZP 061327, 1 specimen, 278 mm TL, June 2001, Tashi.

Diagnosis: D1. II,8-10; P. i17-i18; V. 11-12; GR-I (inner) 1+7; Scales 1D. 3.5-4, 2D. 4.5; Pc. 22-27. Snout moderately long, pointed, 1.5 to 1.7 times in orbit diameter. Teeth in broad, short band in premaxillary, band falling well short of end of rictus. Underside of head naked except for small patch below preopercle angle. Light organ small, length 2.8-3 times orbit diameter; periproct, slightly removed from anal fin origin, fossa of light organ narrow, extending forward immediately before anus, anterior end about equidistant from pelvic fin insertions and anal fin origin. Body scales covered with dagger-like spinules in 3-5 slightly divergent ridge-like rows, median row strongest.

Color: Overall brownish to swarthy, silvery ventrally; fins dusky to blackish; mouth and gill cavities blackish.

Distribution: Southern Japan, East China Sea, and northern Taiwan.

Hymenocephalus Giglioli, 1884

Hymenocephalus Giglioli, 1884: 228 (type species by original designation: *Hymenocephalus italicus* Giglioli).
Mystaconurns Günther, 1887: 124 (as a subgenus of *Macrurus* for *Macrurus longibarbis*).

There are more than 20 species of this genus in the world (Iwamoto 1990; personal data of TI); and 3 species in Taiwan.

Hymenocephalus lethonemus Jordan & Gilbert, 1902
(Fig. 12)

Hymenocephalus lethonemus Jordan and Gilbert, 1902: 615, Sagami Bay, Japan (original description). Weber, 1913: 167. Jordan et al. 1913: 413. Gilbert and Hubbs 1916: 188, 1920: 521. Weber and de Beaufort, 1929: 60. Roxas and Martin, 1937: 62. Kamohara, 1959: 8.

Materials: ASIZP 0061231, 1 specimen, 126 mm TL, May 2000, Tashi; ASIZP 0061232, 12 specimens, 112-124 mm TL, June 2001, Tashi.

Diagnosis: D1. II,9-11; P. i14-i16; V. 11; Scales 1D. 2; GR-I (outer/inner) 18-20/21-25; Pc. 11-16. Body very slender, head low, subquadrate in cross section, width at frontal margin of orbit about as wide as deep. Snout rather long, terminating in a sharp point anteriorly and projecting beyond mouth for a distance slightly less than 1/2 diameter of orbit. Orbit small, subcircular. Mouth large, lateral, considerably oblique. No barbel. Scales large and thin, exposed area with very small, weak spinules arranged in quincunx order, those on breast, belly, and axillary fossa entirely cycloid. Vent just in front of anal fin and preceded by a long luminous organ. Two external lenses present in constant position, anterior one advanced on mid-ventral line beyond pelvic fin base for a distance slightly less than 1/2 orbital diameter, and posterior one, larger than the former, immediately before vent.

Distribution: Southern Japan and northeastern Taiwan.

Hymenogadus Gilbert & Hubbs, 1920

Hymenogadus Gilbert and Hubbs, 1920: 521 (as a subgenus of *Hymenocephalus* for *Hymenocephalus gracilis* Gilbert and Hubbs).

There are 3 species of this genus in the world; 1 species is found in Taiwan.

Hymenogadus gracilis Gilbert & Hubbs, 1920
(Fig. 13)

Hymenocephalus gracilis Gilbert and Hubbs, 1920: 522, fig. 31, China Sea, off southern Luzon (original description). Roxas and Martin, 1937: 62. Kamohara, 1938: 69, 1952: 96.

Materials: ASIZP 061229, 1 specimen, 118 mm TL, Dec. 1999, Nanfangao; ASIZP 061230, 1 specimen, 120 mm TL, Dec. 1999, Nanfangao.

Diagnosis: D1. II,9-12; P. i15-i17; V. 8; Scales 1D. 2, 2D. 3; GR-I (outer/inner) 11-19/8-12; Pc. 105-134. Body slender and subcylindrical, compressed posteriorly. Mouth large, slightly oblique, contained in underside of head. Teeth minute, in narrow bands on both jaws. Barbel slender, usually about as long as 2/3 diameter of orbit. Scales

large, thin, and cycloid. Luminous organ elongated and with 2 external lenses. Black streak present along anterolateral margin of snout, along upper margin of orbit, along inner margin of each lip, and along both sides of mandibular sensory canal. Ventral striae, consisting of alternate lines of black and silver, well developed on isthmus and on ventral regions. Luminous organ, except for lenses, jet black.

Distribution: Southern Japan and northeastern Taiwan.

Kumba Marshall, 1973

Kumba Marshall, 1973: 616 (type species *Kumba dentoni* Marshall, 1973, by original designation).
Parakumba Trunov, 1981: 27 (type species *Parakumba maculisquama* Trunov, 1981, by original designation).

There are 7 species of this genus in the world (Iwamoto and Sazonov 1994); only 1 species occurs in Taiwan.

Kumba japonica (Matsubara, 1943)
(Fig. 14)

Lionurus japonicus Matsubara, 1943: 149-152, fig. 9 (holotype: FAKU 1951, 176 mm TL; Kumano-Nada, Japan; paratype FAKU 1938, 155 mm TL). Kamohara, 1959: 8 (Tosa Bay, Japan).
Nezumia japonicus Okamura, 1970: 88-91, pl. 19, text-fig. 39 (description).
Ventrifossa japonica Okamura, in Okamura et al. 1982: 147, 349, fig. 91 (10 specimens; Japan and Kyushu-Palau Ridge, 550-710 m).

Materials: ASIZP 061240, 1 specimen, 162 mm TL, Dec. 2000, Tungkang; ASIZP 061241, 1 specimen, 156 mm TL, Dec. 2000, Tungkang.

Diagnosis: D1. II,10-11; P. i19-i21; V. 11-12; GR-I (outer/inner) 8-10/12-13; Pc. 40-52. Head firm, non-inflated head sensory canals with prominent pores; scaleless area on dorsal surface of snout extending only to lateral nasal angles; V. 11-12; orbit 36%-43% HL, snout and interorbital much shorter than orbit, snout about 1.25-1.5, interorbital 1.4-1.7 in orbit; ADW and PDW lens-like and widely separated. Three small black pigmented areas near mid-length of anal fin base.

Distribution: Southern Japan and northeastern Taiwan.

Lucigadus lucifer (Smith & Radcliffe, 1912)
(Fig. 15)

Macrourus lucifer Smith and Radcliffe, 1912: 113, pl. 24, fig. 1, Philippine Islands (original description).

Material: ASIZP 061308, 1 specimen, 110 mm TL, Mar. 1999, Nanfangao.

Diagnosis: D1. II,8; P. i14-i20; V. 8; GR-I (outer/inner) 6/11; Scales 1D. 7, 2D. 9. Ventral parts of body appearing to have shifted forward so that anal fin origin often lies below 1st dorsal fin origin; pelvic fins below operculum; snout short, bluntly rounded and high. Pores of head rather prominent. Scales present on lowermost branchiostegal rays. Tip and leading edge of snout without distinct pigmentation. Mandibular teeth in a narrow to wide band; premaxillary teeth not present posterior to hind margin of maxillary process. Spinules on scales in more or less parallel horizontal rows. Abdominal vertebrate 10 to 11.

Distribution: The Philippines and northeastern Taiwan.

Nezumia Jordan, 1904

Nezumia Jordan, in Jordan and Starks, 1902 (1904): 620 (type-species by original designation: *Nezumia condylura* Jordan and Gilbert).
Sphagemacrurus Fowler, 1925: 162 (type-species by original designation: *Macrurus hirundo* Collett).

There are about 46 species of this genus in the world (Iwamoto 1990, Iwamoto and Williams 1999, personal data of TI); only 1 species occurs in Taiwan.

Nezumia condylura Jordan & Gilbert, 1902
(Fig. 16)

Nezumia condylura Jordan and Gilbert, 1902 (1904): 620, Suruga Bay, Japan (original description); Jordan et al. 1913: 413; Kamohara, 1938: 71; 1952: 98.
Lionurus condylura Gilbert and Hubbs, 1916: 195.

Materials: ASIZP 061238, 1 specimen, 186 mm TL, June 2000, Nanfangao; ASIZP 061239, 8 specimens, 124-116 mm TL, Dec. 1999, Nanfangao.

Diagnosis: D1. II,10-13; P. i18-i23; V. 13-17; Scales 1D. 8-9, 2D. 12-13; GR-I (outer/inner) 9-11/7-10; Pc. 25-28. Snout short, blunt; terminal and lateral snout scutes large, blunt; undersides of snout, mandible, most of suborbital, and part of lower margin of preopercle naked; pores prominent in these areas. Teeth in rather broad, tapered bands, outer series in upper jaw slightly enlarged. First dorsal fin with 2 spines, serrations on 2nd spine slender and rather widely spaced. Scales

small, spinules on body scales sharp, needlelike, greatly reclined, in 4 to 16 parallel rows; scales below midbase of 1st dorsal fin 8 or 9, below 2nd dorsal fin 12 or 13. Color: grayish brown, bluish over abdomen; gill membranes blackish; fins dusky, 1st dorsal fin blackish distally; oral and branchial linings blackish.

Distribution: Southern Japan and northeastern Taiwan.

Pseudocetonurus Sazonov & Shcherbachev, 1982

Pseudocetonurus Sazonov and Shcherbachev, 1982: 712, fig. 2 (type locality Sala y Gomez Ridge, 850-860 m; type species: *Pseudocetonurus septifer* Sazonov and Shcherbachev, 1982, by original designation). A monotypic genus.

Pseudocetonurus septifer Sazonov & Shcherbachev, 1982
(Fig. 17)

Pseudoctenurous septifer Sazonov and Shcherbachev 1982: 712, fig. 2 (type locality Sala y Gomez Ridge, 850-860 m). Parin, 1990: 16-17 (listed from Nazca and Sala y Gomez Ridges). Iwamoto in Cohen et al. 1990: fig. 229 (in key).

Material: ASIZP 061237, 1 specimen, 147 mm TL, May 2001, Tashi.

Diagnosis: D1. II,8-12; P. i16-i20; V. 8; Scales 1D.-A. 33-39, 2D.-A. 18-24; GR-I (outer/inner) 7-12/(1-2)+(12-16), GR-II (1-3)+(12-15); Pc. 22-34. Macrourinae with 7 branchiostegal rays. Head notably large and broad; preopercle and suborbital bones deep and large, opercle commensurately small; orbit small, 19%-30% HL, diameter much less than broad interorbital; snout high, slightly projecting beyond mouth. Mental barbel small, 10% or less of HL. Gill opening wide, extending forward to below hind end of maxilla; gill membranes loosely and narrowly attached to isthmus. Gill rakers usually 16 or 17 on inner series of 1st arch. Teeth small, close-set, in narrow tapered band on premaxilla, uniserial on dentary. Scales with numerous small, awl-shaped spinules; no reticulations on anterior field; lateral line scales absent, a series of dark papillae in their place. Vent about halfway between pelvic fin insertion and anal fin origin (usually closer to pelvic insertion), surrounded by a black, oval to teardrop-shaped naked area and preceded by a small, round dermal window of light organ between pelvic fin bases. Pyloric caeca short, 22-34. Color black to dark brown overall.

Distribution: Known from Hawaii, the southeastern Pacific, and Taiwan.

Remarks: Only the single species is known.

Ventrifossa Gilbert & Hubbs, 1920

Ventrifossa Gilbert and Hubbs, 1920: 543 (type species *Coryphaenoides garmani* Jordan and Gilbert, 1904, by original designation).

There are 22 species of this genus in the world; 10 are found in Taiwan.

Ventrifossa atherodon (Gilbert & Cramer, 1897)
(Fig. 18)

Optonurus atherodon Gilbert and Cramer, 1897: 431, pl. 46, fig. 1 (Kaiwi Channel, Hawaiian Islands, 686 m).
Lionurus (*Nezumia*) *atherodon* Gilbert and Hubbs, 1916: 145.
Ventrifossa (*Atherodus*) *atherodon* Gilbert and Hubbs, 1920: 544.

Material: ASIZP 0061311, 1 specimen, 245 mm TL, Mar. 2001, Tashi.

Diagnosis: D1. II,9-11; P. i19-i23; V. 11-12; GR-I (outer/inner) 10-14/16-20; GR-II 16-19; Scales 1D. 8.5-10.5. Teeth in premaxilla in broad bands, those in outer series distinctly enlarged, conical, recurved canines with arrowhead-shaped tips; mandibular teeth in 2 irregular series, inner series slightly enlarged. First dorsal fin with 2 spines and 9 or 10 rays, 1st spinous ray lacking serrations. Scales small; spinules very small, short, conical, erect; scale rows below 2nd dorsal fin origin 7 or 8; over a distance equal to predorsal length, 47 to 56. Snout with black margins along leading edge, supranarial ridges, and a median nasal ridge; 1st dorsal fin uniformly dusky.

Distribution: Hawaiian Islands and northeastern Taiwan.

Ventrifossa divergens Gilbert & Hubbs, 1920
(Fig. 19)

Ventrifossa divergens Gilbert and Hubbs, 1920: 100; 1(7): 549, fig. 37 (Sibuko Bay, Borneo; 557 m; *ALBATROSS* stn. 5592).

Materials: ASIZP 061309, 1 specimen, 220 mm TL, Dec. 2000, Tungkang; ASIZP 061310, 1 specimen, 182 mm TL, June 2001, Tashi.

Diagnosis: D1. II,9-11; P. i19-i23; V. 8-9; GR-I (outer/inner) 15-17; Scales 2D. 8-10. Teeth small, in broad bands in premaxilla, outer series slightly enlarged, some with arrowhead tips; mandibular teeth in rather narrow band. First dorsal fin with 2

Table 1. Taxonomic history of 40 species of Macrouridae from Taiwan

No.	Scientific name	Chinese name	Shen, 1984	Chen & Yu, 1986	Shen et al. 1993	Other publication
*1	*Bathygadus antrodes*	孔頭底尾鱈				(s) *Melanobranchus antrodes* Jordan & Gilbert, 1902
*2	*Bathygadus garretti*	鬚底尾鱈				
*3	*Bathygadus nipponicus*	日本底尾鱈				(s) *Regania nipponica* Jordan & Gilbert, 1902
*4	*Gadmus colletti*	鞭鼠鱈				
5	*Caelorinchus* (*Oxymacrurus*) *anatirostris*	鴉嘴腔吻鱈			+	
*6	*Caelorinchus* (*Oxymacrurus*) *asteroides*	擬星腔吻鱈				
7	*Caelorinchus* (*Paramacrurus*) *cinguletus*	帶斑腔吻鱈	+	*x C. dorsalis*	*x C. dorsalis*	(n) Gilbert & Hubbs, 1920
**8	*Caelorinchus* (*Oxygadus*) *sheni*	沈氏腔吻鱈				
9	*Caelorinchus* (*Quincuncia*) *formosanus*	臺灣腔吻鱈		+	+	(n) Okamura, 1963
#10	*Caelorinchus* (*Oxygadus*) *gilberti*	吉氏腔吻鱈		+	+	
11	*Caelorinchus* (*Quincuncia*) *hubbsi*	哈氏腔吻鱈			+	
12	*Caelorinchus* (*Oxymacrurus*) *japonicus*	日本腔吻鱈			+	(s) *Macrurus japonicus* Temminck & Schlegel, 1842
13	*Caelorinchus* (*Quincuncia*) *kamoharai*	蒲原氏腔吻鱈	+	+	+	
14	*Caelorinchus* (*Paramacrurus*) *kishnouyei*	胸斑腔吻鱈	+	+	+	
*15	*Caelorinchus* (*Oxymacrurus*) *leptorhinus*	窄吻腔吻鱈		*x C. tokiensis*		(n) Chiou et al. 2004
*16	*Caelorinchus* (*Quincuncia*) *logispinosus*	長絲腔吻鱈				(n) Chiou et al. 2004
*17	*Caelorinchus* (*Quincuncia*) *longissimus*	長管腔吻鱈				
18	*Caelorinchus* (*Quincuncia*) *multispinulosus*	多棘腔吻鱈	+	+	+	
#19	*Caelorinchus* (*Oxygadus*) *parallelus*	平棘腔吻鱈			+	(s) *Macrurus parallelus* Günther, 1877
*20	*Caelorinchus* (*Oxymacrurus*) *productus*	東海腔吻鱈				
21	*Caelorinchus* (*Oxymacrurus*) *smithi*	斯氏腔吻鱈			+	
22	*Coryphaenoides microps*	大眼突吻鱈			x	
*23	*Hymenocephalus lethonemus*	刺紋膜首鱈				
24	*Hymenocephalus longiceps*	長頭膜首鱈	+	+	+	(+) Gilbert & Hubbs, 1920
25	*Hymenocephalus striatissimus*	紋喉膜首鱈	+	+	+	(+) Gilbert & Hubbs, 1920
*26	*Hymenogadus gracilis*	細長膜鱈				
*27	*Kumba japonica*	日本舟尾鱈				
28	*Malacocephalus laevis*	滑軟首鱈		+	+	(x) Okamura, 1970a
*29	*Nezumia condylura*	獅鼻奈氏鱈			+	
*30	*Pseudoctenurous septifer*	偽鯨尾鱈				
*31	*Ventrifossa atherodon*	箭齒凹腹鱈				(s) *Optonurus atherodon* Gilbert & Cramer, 1897
*32	*Ventrifossa divergens*	歧異凹腹鱈				
33	*Ventrifossa garmani*	加氏凹腹鱈	+	+	+	(s) *Coryphaenoide garmani* Jordan & Gilbert, 1902
*34	*Ventrifossa longibarbata*	長鬚凹腹鱈				
*35	*Ventrifossa lucifer*	魔燈凹腹鱈				(s) *Macrourus lucifer* Smith & Radcliffe, 1912
*36	*Ventrifossa macroptera*	大鰭凹腹鱈				
37	*Ventrifossa nigrodorsalis*	黑背鰭凹腹鱈	+	+	+	(n) Gilbert & Hubbs, 1920
38	*Ventrifossa nigromarginata*	黑緣凹腹鱈			+	(s) *Macrourus nigromarginata* Simth & Radcliffe, 1912
*39	*Ventrifossa rhipidodorsalis*	扇鰭凹腹鱈				
*40	*Ventrifossa saikaiensis*	西海凹腹鱈				

* new record ** new species # specimen lost x misidentified s synonym + species reported correctly n correctly recorded for the first time

spines and 9 to 11 rays, spinous ray finely serrated along leading edge. Scales medium-sized, uniformly covered with fine, conical, reclined spinules in widely divergent V-rows or quincunx order; scale rows below 2nd dorsal fin 8 to 10; over distance equal to predorsal length 43 to 48. Snout with a black margin along leading edge extending posteriorly onto suborbital shelf, but not over supranarial or median nasal ridges; 1st dorsal fin uniformly dusky or darker proximally, but lacking a distinct black blotch.

Distribution: The Philippines, South China Sea near Hong Kong, Borneo, Indian Ocean off South Africa, Mozambique, southern Japan, and Taiwan.

Ventrifossa longibarbata **Okamura, 1982**
(Fig. 20)

Ventrifossa longibarbata Okamura, 1982: 156 (Kyushu-Palau Ridge; 605 m).

Materials: ASIZP 061242, 1 specimen, 272 mm TL, Dec. 2000, Tungkang; ASIZP 061243, 3 specimens, 182-268 mm TL, Dec. 2000, Tungkang.

Diagnosis: D1. II, 9-10; P. i21-i23; V. 8-9; GR-I (outer/inner) 10-12; Scales1D. 12-14, 2D. 9-10, Pc. 70. Mouth inferior, lower jaw tipped with a long barbel, relatively small body scales, and spineless scales behind 1st dorsal fin. Head comparatively small; snout short and broad, angulated along anterolateral edge; tip of snout without spinulous tubercle. Teeth conical, with band on both jaws. Second dorsal spine finely serrated except for basal portion. Spinules on body scales slender, not triangular in shape, arranged in quincunx order. Luminous organ small, between pelvic bases. Sides of head and body bright silvery. First dorsal fin blackish, with white base and tip.

Distribution: Southern Japan and southeastern Taiwan.

Ventrifossa macroptera **Okamura, 1982**
(Fig. 21)

Ventrifossa macroptera Okamura, 1982, Tokyo: 148 (Kyushu-Palau Ridge; 685-710 m).

Materials: ASIZP 061244, 1 specimen, 199 mm TL, May 2001, Tungkang; ASIZP 061245, 1 specimen, 202 mm TL, May 2001, Tungkang.

Diagnosis: D1. II, 9-11; P. i21-i26; V. 9-10; GR-I (outer/inner) 11-17; GR-II 16-19; Scales 1D. 6-8, 2D. 8-10. Premaxillary teeth in narrow bands 4 or 5 teeth wide, outer series enlarged with arrowhead-like tips; mandibular teeth in 2 series, the inner large. First dorsal fin with 2 spines and 9 to 11 rays, 2nd spinous ray smooth. Scale rows below midbase of 1st dorsal fin 6.5 to 7.5, below 2nd dorsal origin 8 to 10; lateral-line scales over a distance equal to predorsal length 49 to 55. Scales covered with slender, sharp spinules in 5 widely divergent rows or irregularly in quincunx order. Snout with a black margin along leading edge and posteriorly over 1/2 of supranarial ridges; 1st dorsal fin uniformly blackish or dusky.

Distribution: Kyushu-Palau Ridge, Hawaiian Islands, southern Japan, and northeastern Taiwan.

Ventrifossa rhipidodorsalis **Okamura, 1984**
(Fig. 22)

Ventrifossa rhipidodorsalis Okamura, 1984: 204 (Okinawa Trough; 500-535 m).

Materials: ASIZP 061246, 1 specimen, 170 mm TL, June 2000, Nanfangao; ASIZP 061247, 12 specimens, 142-168 mm TL, Dec. 1999, Nanfangao.

Diagnosis: D1. II,9-12; P. i18-24; V. 9-11; GR-I (outer/inner) 10-2+14; Scales 1D. 5-6.5, 2D. 7-8.5; Pc. 52-69. Mouth inferior with narrow tooth band on lower jaw, a large area of spineless scales behind 1st dorsal fin, and slender dense spinules on scales. Ventral luminous organ rather large, situated between pelvic bases and connected with black periproct by narrow naked groove; lens faintly visible on photophore. First dorsal largely blackish, white distally and basally. Anterior portion of anal fin with narrow black margin. Vent located before a vertical through origin of 1st dorsal fin.

Distribution: The Philippines, South China Sea, southern Japan, and northeastern Taiwan.

Ventrifossa saikaiensis **Okamura, 1984**
(Fig. 23)

Ventrifossa saikaiensis Okamura, 1984: 208 (type locality; Okinawa Trough; 700-740 m).

Materials: ASIZP 0061248, 1 specimen, 250 mm TL, May 2001, Tashi; ASIZP 0061249, 18 specimens, 164-226 mm TL, May 2001, Tashi.

Diagnosis: D1. II, 9-11; P. i9-i22; V. 8-9; GR-I (outer/inner) 14/17; Scales 1D. 5-6, 2D. 7-7.5; Pc. 52. Mouth inferior with long barbel, mandibular teeth in very narrow band, and slender dense spinules arranged in convergent rows or quincunx order on scales. A few or no spineless scales

behind 1st dorsal. Scale sacs on upper 1/2 of body and along base of anal fin with narrow, dark-brown posterior margin. Ventral luminous organ comparatively large, situated between pelvic bases and connected with periproct by narrow naked groove. Snout more or less pointed. Mouth moderately large, upper jaw extending to a vertical from posterior rim of orbit. Upper lip with rather broad dark margin. Vent much nearer to pelvic base than to anal fin. First dorsal fin uniformly dark.

Distribution: Southern Japan and northeastern Taiwan.

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REFERENCES

Alcock A. 1891. On the deep-sea fishes collected by the "Investigator" in 1890-1891. Ann. Mag. Nat. Hist., Ser. **6, 8:** 16-34, 119-138, pls. vii-viii.

Alcock A. 1894. Natural history notes from H.M. Indian Marine Survey Steamer "Investigator", Commander C.E. Oldham. R. N., commanding Series 2, No. 11. An account of a recent collection of bathyal fishes from the Bay of Bengal and from the Laccadive Sea. J. Asiatic Soc. Bengal. **63:** 115-137, pls. 6-7.

Chen JT, MZ Yu. 1986. A synopsis of the vertebrates of Taiwan. Taipei: Commercial Books, 442 pp. (in Chinese)

Chiou ML, KT Shao. T Iwamoto, 2004. A new species of *Caelorinchus* (Macrouridae, Gadiformes, Teleostei) from Taiwan, with a redescription of *C. brevirostris* Okamura. Copeia (in press).

FAO. 1985. Macrouridae (sometimes Coryphaenoididae and Macrouroididae, in part, in literature), Grenadiers. Rome: FAO. Species Identification Sheets, pp. 288-301.

Fowler HW. 1925. New taxonomic names of West African marine fishes. Am. Mus. Novit. **162:** 3.

Gilbert CH. 1905. The deep-sea fishes of the Hawaiian Islands. *In* DS Jordan, BW Evemann, eds. The aquatic resources of the Hawaiian Islands. Bull. US Fish Comm., (for 1903), **22:** 575-713, figs. 230-276, pls. 66-101.

Gilbert CH, F Cramer. 1897. Report on the fishes dredged in deep water near the Hawaiian Islands, with descriptions and figures of twenty-three new species. Proc. US Natl. Mus. **19:** 403-435, pls. 36-48.

Gilbert CH, CL Hubbs. 1916. Report on the Japanese macrouriod fishes collected by the United States Fisheries Steamer "Albatross" in 1906, with a synopsis of the genera. Proc. US Natl. Mus. **51:** 135-214, pls. 8-11.

Gilbert CH, CL Hubbs 1920. The Macrouroid Fishes of the Philippine Islands and the East Indies. US Natl. Mus. Bull. **100, 1:** 369-588.

Gilbert CH, WF Thompson. 1916. Family Macrouridae. *In* WF Thompson, ed. Fishes collected by the United States Bureau of Fisheries Steamer "Albatross" during 1888, between Montevideo, Uruguay, and Tome, Chile, on the voyage through the Straits of Magellan. Proc. U.S. Natl. Mus. **50:** 401-476, pls. 2-6.

Giorna ME. 1809. Memoire sur des poissons d'especes nouvelles et du genres nouveaux. Mem. Acad. Sci. Turin (1805-1808) **2:** 177-180.

Günther A. 1878. Preliminary notes on new fishes collected in Japan during the expedition of HMS "Challenger". Ann. Mag. Nat. Hist., Ser **5, 2:** 17-28.

Günther A. 1887. Report on the deep-sea fishes collected HMS "Challenger" during the years 1873-1876. Rep. Sci. Res. Challenger, Zool. **22:** 1-335.

Iwamoto T. 1970. The R/V "Pillsbury" deep-sea biological expeditions to the Gulf of Guinea, 1964-1965. 19 Macrouride fishes of the Gulf of Guinea. Stud. Trop. Oceanogr. Univ. Miami. **4:** 316-431.

Iwamoto T. 1973. Macrourids (Gadiformes: Pisces) collected off Angola by the R/V UNDAUNTED with the description of a new species. Proc. Biol. Soc. Wash. **86:** 373-384, figs. 1-4, tables 1-2.

Iwamoto T. 1974. *Nezumia* (*Kuronezumia*) *bubonis*, a new subgenus and species of grenadier (Macrouridae: Pisces) from Hawaii and the western North Atlantic. Proc. CA Acad. Sci., Ser. **4, 39:** 507-516, figs. 1-3.

Iwamoto T. 1979. Eastern Pacific macrourine grenadiers with seven branchiostegal rays (Pisces: Macrouridae). Proc. CA. Acad. Sci. **42:** 135-179.

Iwamoto T. 1984. Macrouridae. *In* W Ficher, G Bianchi, eds. FAO species identification sheets for fishery purpose. Western Indian Ocean, Fishing Area 51. Prepared and printed with the support of DANIDA. Rome: FAO 3, 8.

Iwamoto T. 1986. Family no. 93: Macrouridae. *In* MM Smith, PC Heemstra, eds. Smith's sea fishes. Johannesburg: Macmillan South Africa, pp. 330-341.

Iwamoto T. 1990. Taxonomy of Macrouridae. FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other Gadiform fishes know to date. FAO, Fisheries Synopsis No. 125. Rome: FAO 90-317.

Iwamoto T, P McMillan, YN Shcherbachev. 1999. A new grenadier, genus *Caelorinchus* from Australia and New Zealand (Pisces, Gadiformes, Macrouridae). New Zeal. J. Mar. Fresh. **33:** 49-54.

Iwamoto T, NR Merrett. 1997. Pisces Gadiformes: taxonomy of grenadiers of the New Caledonian region, southwest Pacific. Mem. Mus. Natl. D'Hist. Nat. **176:** 473-570.

Iwamoto T, YI Sazonov. 1988. A review of the southeastern Pacific *Coryphaenoides* (sensu lato) (Pisces, Gadiformes, Macrouridae). Proc. CA Acad. Sci. **45:** 35-81.

Iwamoto T, YI Sazonov. 1994. Revision of the genus *Kumba* (Pisces, Gadiformes, Macrouridae), with the description of three new species. Proc. CA Acad. Sci. **48:** 221-237.

Iwamoto T, DL Stein. 1974. A systematic review of the rattail fishes (Macrouridae: Gadiformes) from Oregon and adjacent waters. Occas. Papers CA Acad. Sci. **111:** 1-79.

Jordan DS, CH Gilbert. 1904. Macrouridae. *In* DS Jordan, EC Starks, eds. List of fishes dredged by the steamer Albatross off the coast of Japan in the summer of 1990, with descriptions of new species and a review of the Japanese

Macrouridae. Bull. US Fish Comm. (1902) **22:** 577-630, pls. 1-8.

Jordan DS, S Tanaka , JO Snyder. 1913. A catalogue of the fishes of Japan. J. Coll. Sci. Imp. Univ. Tokyo **33:** 1-497, 396 figs.

Kamohara T. 1952. Revised descriptions of the offshore bottom-fishes of Prov. Tosa, Shikoku, Japan. Rept. Kochi Univ. Nat. Sci. **3:** 1-122.

Kamohara T. 1959. New records of fishes from Kochi Prefecture, Japan. Rept. USA. Mar. Biol. Stn. **6:** 1-8, pl. 1.

Marshall NB. 1973. Family Macrouridae. *In* DM Cohen, ed. Fishes of the Western North Atlantic. Mem. Sears Found. Mar. Res. **1:** 496-665.

Marshall NB, DM Cohen. 1973. Order Anacanthini (Gadiformes) - characters and synopsis of families. Mem. Sears Found. Mar. Res. **1:** 479-495.

Matsubara K. 1943. Ichthyological annotations from the depth of the sea of Japan. IX. On three new macrouroid fishes referable to the genera *Caelorhynchus* and *Lionurus*. J. Sigenkagaku Kenkyusyo **1:** 144-152, figs. 6-8.

Matsubara K. 1955. Fish morphology and hierarchy, Parts I, II, and III. Tokyo: Ishizaki Shoten, pp. 791-1605. (in Japanese)

McMillan PJ, CD Paulin. 1993. Descriptions of nine new species of rattails of the Genus [*Caelorinchus*] (Pisces, Macrouridae) from New Zealand. Copeia **1993:** 819-840.

Okamura O. 1963. Two new and one rare macrouride fishes of the genera *Caelorhynchus* and *Lionurus*, found in Japan waters. Bull. Misaki Mar. Biol. Inst. Kyoto Univ. **4:** 21-35, 10 figs.

Okamura O. 1970. Fauna Japonica, Macrourinae (Pisces). Tokyo: Academic Press of Japan, 216 pp, 64 pls.

Okamura O, K Amaoka, F Mitani, eds. 1982. Fishes of the Kyushu-Palau Ridge and Tosa Bay. Tokyo: Jpn. Fish. Res. Conserv. Assoc., 435 pp.

Okamura O, T Kitajima, eds. 1984. Fishes of the Okinawa trough and the adjacent waters. The intensive research of unexploited fishery resources on continental slopes. Tokyo: Jpn. Fish. Res. Conserv. Assoc., 414 pp.

Regan CT. 1903. On the systematic position and classification of the gadoid or anacanthine fishes. Ann. Mag. Nat. Hist. Ser. **7, 11:** 459-466.

Roxas HA, C Martin. 1937. A check list of Philippine fishes. Manila: Commonw. Philippines Dept. Agric. Comm. Tech. Bull. **6:** 1-314.

Sazonov YI, YN Shcherbachev. 1982. A preliminary review of grenadiers related to the genus *Cetonurus* Günther (Gadiformes, Macrouridae). Descriptions of new taxa related to the genera *Cetonurus* Günther and *Kumba* Marshall. Voprosy Ikhtiologii, Akad. Nauk SSR **22:** 707-721. (in Russian, with English summary)

Shen SC. 1984. Synopsis of fishes of Taiwan. Taipei: Southern Materials Center, pp.143-146. (in Chinese)

Shen SC, SC Lee, KT Shao, HK Mok, CT Chen, CS Tzeng. 1993. Fishes of Taiwan. Taipei: Dept. Zool. Natl. Taiwan Univ., 960 pp. (in Chinese)

Smith HM, L Radcliffe. 1912. Description of a new family, two new genera and twenty-nine new species of Anacanthine fishes from the Philippine Islands and contiguous waters. Proc. US Natl. Mus. **43:** 105-140, pls. 22-31.

Steindachner F, L Döderlein. 1887. Beitrage zur Kenntniss der Fische Japans. I-IV. Denk. Nat. Ak.-Wiss. Wien. **43:** 257, 4 pls.

Trunov IA. 1981. *Paracumba maculisquama*, a new genus and species of Macrourid family from southern Atlantic (Macrouridae). Vol. 21. Voproody Ikht. Fasc. **1:** 28-36. (in Russian)

Weber M. 1913. Die Fische der Siboga-Expedition. Leiden: Siboga-Expeditie, 710 pp, 123 figs.